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Leslie, W. H. P.

Electronics (3)
Electronic Tubes (8)
Tubes, Electronic (95220)

EL-1408

Effect of life tests on electronic tube type CV287 (Neon stabiliser)

Royal Aircraft Establishment, Farnborough, Hants

Gt. Brit Eng. Unclass. Unclass. Dec'46 14 tables, graphs

The effect of life tests on electronic tube type CV287 (Neon stabiliser) is presented. The CV287, a neon stabiliser used as a source of a reference voltage in electronic regulators and radio equipment is described. Tests on 12 samples show that the tube has a voltage stability of 2 per cent for 1000 hours, 0.7 per cent for 250 hours, and 0.7 per cent for 24 hours. Attention is drawn to the necessity for improving the interservice specification for this stabiliser.

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REPORT No: EL. 1408

ROYAL AIRCRAFT ESTABLISHMENT

Farnborough, Hants.

EFFECT OF LIFE TESTS ON ELECTRONIC VALVE TYPE CV287 (NEON STABILIZER)

by

W. H. P. LESLIE, B.Sc.

Class No. 621.385.22.032.182.004.62:621.316.722.1

Report No. El.1408

December, 1946.

ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH

Effect of Life Tests on Electronic Valve Type CV287 (Neon Stabilizer)

by

W.H.P.Leslie, B.Sc.

R.A.E. Ref: EL/G.3992/140

SUMMARY

The CV287 is used as a source of a reference voltage in Electronic Regulators and Radio Equipment. Tests on 12 samples show that the valve has a voltage stability of 2% for 1000 hours, 0.7% for 250 hours, 0.7% for 24 hours. Attention is drawn to the necessity for improving the Interservice Specification for this stabilizer.

Further tests, based on a larger number of samples, are necessary to give more representative results. A continuous record of voltage variations on a number of stabilizers would show whether the day-to-day variations occur in intermittent jumps or slow changes, but it is not proposed to carry out these tests.

LIST OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

1 Introduction

1.1 The increasing use of electronic regulators has caused a demand for an e.m.f. or voltage drop which has a fixed value indpendent of life.

1.2 The neon stabilizer has been used to obtain a constant voltage drop, reasonably independent of life and current.

1.3 This report deals with tests carried out during February and March, 1946, on the CV287, a neon stabilizer with the following characteristics[1].

Striking Voltage less than 170, with aux. anode suitably connected.

Voltage Drop at 5 m.a.	145 to 160 volts.
Change in Voltage when current is changed from 2 m.a. to 10 m.a.	5 volts maximum.
Size	54 mm. by 19 mm. dia.

1.4 The tests were carried out under laboratory conditions (temperature 15°C. to 25°C.) and the voltage of each stabilizer was recorded at 24 hour intervals. Fluctuations occurring during shorter intervals were not recorded.

2 Method of Test

2.1 An accuracy of 0.1% being required, substandard voltmeters were not suitable for reading the volt drop. A simple potentiometer, standardised daily against a standard cell, was used. The accuracy obtained was better than ±0.1 volts in 150 and the potentiometer required a current of approximately 1 milliamp. from the voltage being measured.

2.2 Each stabilizer was supplied through a fixed resistor from a regulated 300 volt supply, which was adjusted to 300 volts ±0.4 each day. The value of each resistor was chosen to give approximately the required current for a stabilizer of nominal voltage. This is representative of the normal use of the stabilizer. 4 stabilizers were operated at 3 milliamp., 4 at 6 milliamp., and 4 at 9 milliamp.

2.3 As described in 2.1 the potentiometer required approximately 1 m.a. due to low input impedance. This caused the neon stabilizer current during the voltage measurement to be 1 m.a. less than its running value. This had no bad effect since the current did not fall below the minimum regulating value.

3 Results of Test

3.1 The tests were carried on for 1,000 hours, the life generally required for airborne equipment.

3.2 Figures 1 to 6 show the variations in voltage throughout 1,000 hours for each stabilizer. The zero of the voltage scale has been suppressed, and the voltage level varies, but the voltage scale is the same in each figure to facilitate comparison. Since the changes in voltage are erratic in magnitude and sign the points have been joined by straight lines rather than smooth curves.

3.3 An alternative presentation of the results is given in Tables I and II. Table I states the maximum and minimum voltages of each stabilizer during intervals of 250 hours. This shows the long term stability. The maximum variation during 1000 hours is also stated.

Table I

Extremes of Voltage (250 hour periods)

Stabilizer No.	Test Current	Initial Voltage	0 to 250 hrs.		250 to 500 hrs.		500 to 750 hrs.		750 to 1000 hrs.		Maximum Variation	Average Variation
			Highest	Lowest	High	Low	High	Low	High	Low		
1	2.9 m.a.	150.2	150.7	150.2	150.5	149.8	150.0	149.6	150.0	149.5	1.2	
2	2.9 m.a.	148.5	150.0	148.3	150.0	149.0	149.3	149.0	149.4	149.0	1.7	1.9
3	2.9 m.a.	150.6	150.6	147.4	148.0	147.8	148.2	147.8	148.2	148.0	3.2	
4	2.9 m.a.	146.7	146.7	145.6	146.1	145.5	147.1	145.6	146.6	146.0	1.6	
5	5.9 m.a.	147.6	148.9	147.6	148.9	148.2	148.8	148.3	149.1	148.6	1.5	3.0
6	5.9 m.a.	140.6	145.1	140.6	145.7	144.9	146.5	145.6	147.3	146.1	6.7	
7	6.0 m.a.	147.2	149.2	147.2	149.1	148.1	148.4	147.9	149.1	148.3	2.0	
8	5.9 m.a.	148.7	149.3	148.5	149.2	148.3	149.9	148.8	149.0	148.3	1.6	1.7 neglecting No.6.
9	9.3 m.a.	150.3	150.6	150.0	150.6	149.5	150.4	149.7	150.2	149.1	1.5	
10	9.4 m.a.	148.5	149.7	148.5	149.7	149.0	149.7	149.2	150.3	149.6	1.8	2.0
11	9.3 m.a.	146.2	148.6	146.2	148.6	147.8	148.5	148.0	148.9	148.0	2.7	
12	9.2 m.a.	146.3	148.2	146.3	148.2	147.4	148.3	147.8	148.3	147.6	2.0	

Extreme values during 1000 hours are underlined.

Table II

Significant Rates of Voltage Change

Stabilizer No.	3 m.a.						6 m.a.										9 m.a.							
	1		2		3		4		5		6		7		8		9		10		11		12	
	Volts	Hours	V	h	V	h	V	h	V	h	V	h	V	h	V	h	V	h	V	h	V	h	V	h
0 to 150 hours	+0.5	72	+0.3	24	-3.1	24	-0.9	48	+0.7	24	+3.1	24	+1.1	24	±0.2	24	-0.3	24	+0.3	24	+0.9	24	+0.3	48
	+0.2	24	-0.4	24	+0.5	150	+0.4	72	+0.7	24	-1.1	24	-0.2	24	+0.5	72	+0.6	120	+0.6	72	+0.8	48	-0.3	24
	−1.0	150	+0.3	24	+0.2	24	+0.2	24	-0.2	24	+1.6	100	+0.4	72	-0.2	24	-0.6	48	-0.4	48	+0.7	72	+0.7	24
	+0.3	48	-0.4	24	-0.2	72	−0.7	48	+0.3	48	+0.7	48	+0.6	24	+0.5	48	+0.6	24	+0.5	24	-0.3	72	+0.7	72
			+1.7	72			+0.5	48	-0.6	48	+0.5	48	-0.2	24	-0.5	24	-1.1	48	-0.5	30	+0.5	24	+0.6	48
			-1.0	48					+0.4	48	-0.7	24	-0.6	48	+0.4	24	+0.9	150	+0.7	150	-0.8	48	-0.7	48
											+0.5	24			-0.9	48					+0.7	150	+0.9	150
															+0.3	48								
500 to 1000 hrs.	-0.3	24	-0.2	48	+0.2	48	-0.5	72	-0.4	48	+0.4	24	-0.4	75	-0.7	72	-0.6	72	-0.5	75	-0.5	72	-0.5	72
	+0.2	24	+0.2	96	+0.2	48	+0.3	72	+0.4	72	-0.3	48	+0.4	100	+0.4	72	+0.4	24	+0.5	100	+0.4	100	+0.4	96
	-0.4	96	-0.3	150	-0.2	150	+1.2	48	+0.4	48	+0.3	72	+0.2	50	-0.4	50	-0.6	24	-0.3	48	-0.3	48	-0.4	48
	+0.4	96	+0.5	48			-0.9	24	-0.2	48	+0.3	24	+0.7	24	+0.7	24	+0.3	48	+0.9	100	+0.7	48	+0.4	48
	-0.5	120	-0.3	72			+0.4	96			-0.4	48	-0.3	24	-0.5	48	-0.9	48	-0.3	24	-0.3	48	-0.4	150
			-0.3	24			-0.5	48			+0.5	48	-0.5	72	-0.3	24	+1.1	48	-0.4	24	-0.5	24	-0.3	24
							+0.6	48			+0.6	72	-0.4	72			-0.2	48						
							-0.3	24									-0.5	24						

The right hand column states the average (for each 4 stabilizers tested under identical conditions) of the maximum variation.

Table II shows the larger rates of change of voltage stated as X volts in Y hours. This gives an indication of the day-to-day stability of the voltage.

4 Comments on Test Results

4.1 Tests carried out on 12 stabilizers, probably from the same batch, cannot give definite information of the best or worst qualities of the stabilizer, but the properties may regarded as more extreme than the results obtained.

4.2 There is no sign of excessive voltage rise towards the end of life, indicating that the stabilizer is adequately rated.

4.3 Table I (or figures 1 to 6) shows that

(a) The change in the first 250 hours was as large as 4.5 volts (No.6), 3.2 volts (No.3), and 2.4 volts (No.11).

(b) In each subsequent 250 hours the maximum change was of the order of 1.0 volts.

No.1, No.5, and No.12 were better with a change of 0.7 to 0.8 volts.

(c) The change in 1000 hours varied between 1.2 volts and 3.2 volts (with the exception of No.6 which may be seen in Fig.3 to have a defect causing a progressive rise in voltage with life. Maximum change 6.7 volt).

(d) If No.6 is disregarded the change in voltage over 250 hour periods, and over 1000 hours, is seen to be independent of operating current.

(e) Table II (or figures 1 to 6) show that changes as high as ± 3 volts occurred in 24 hours (Nos.3 and 6). If No.6 is neglected it is noteworthy that in the case of No.3 the change of -3.1 volts occurred in the first 24 hours and after a return of +0.5 volts in 150 hours there was no change greater than 0.2 volts in 24 hours.

In addition stabilizers Nos.1, 2, 4, 7, 9, 10, 11, all had changes of the order of ± 1 volt in 24 to 150 hours.

No.2 had a change of +1.7 in 72 hours.
No.7 had a change of +1.1 in 24 hours.

4.4 The specification[1] for this valve gives no indication of the required stability from second to second, or during the unstated life of the valve, only requiring the voltage to be between 145 and 160 volts at 5 m.a. when new. It does not specify whether the voltage should increase or decrease when the current changes from 2 to 10 milliamp. so that at 2 or 10 milliamp. the voltage limits are 140 to 165 volts.

Table I shows that apart from No.6 all the stabilizers would be within these limits throughout their life.

5 Conclusions

5.1 The CV287 may be used as a voltage reference source providing variations of the following order can be tolerated.

(1) ±2% in 1000 hours.

(2) ±0.7% in 250 hours.

(3) ±0.7% in 24 hours.

5.2 In what may be exceptional stabilizers, changes occurred as great as:-

(1) 4% in 1000 hours (No.6).

(2) 2% and 3% in 250 hours (Nos.3 and 6).

(3) 2% in 24 hours (Nos.3 and 6).

5.3 The best performances in a 250 hour period were:-

(1) ±0.15% (No.3).

(2) ±0.2% (No.2).

(3) ±0.3% 8 out of 12 stabilizers at some particular part of their life.

5.4 The specification rating of 2 m.a. to 10 m.a. appears to lead to a satisfactory life.

5.5 The inter-service specification could be improved (see 4.4).

5.6 A greater number of samples with different manufacturing histories would have to be tested to obtain data justifying design of equipment relying on the stabilities quoted in this report.

5.7 No account has been taken of changes occurring in intervals shorter than 1 day although it is suspected that the change in 5 minutes may be of the same order as that recorded for 1 day.

Tests using an accurate recording system are necessary, but not contemplated at present.

5.8 The voltage of the CV287 is more stable than that of the CV188[2] for periods greater than 24 hours.

5.9 The voltage of the CV287 is considerably more stable than that of CV286[3].

References

1. Specification MOS/CV287/Issue 3.

2. Effect of Life Tests on Electronic Valve Type CV188. (Neon Stabilizer). R.A.E. Report El.1406.

3. Effect of Life Tests on Electronic Valve Type CV286. (Neon Stabilizer). R.A.E. Report El.1407.

Attached:

Figures 1 to 6. Drgs. No. EL.15170 to 15175 incl.

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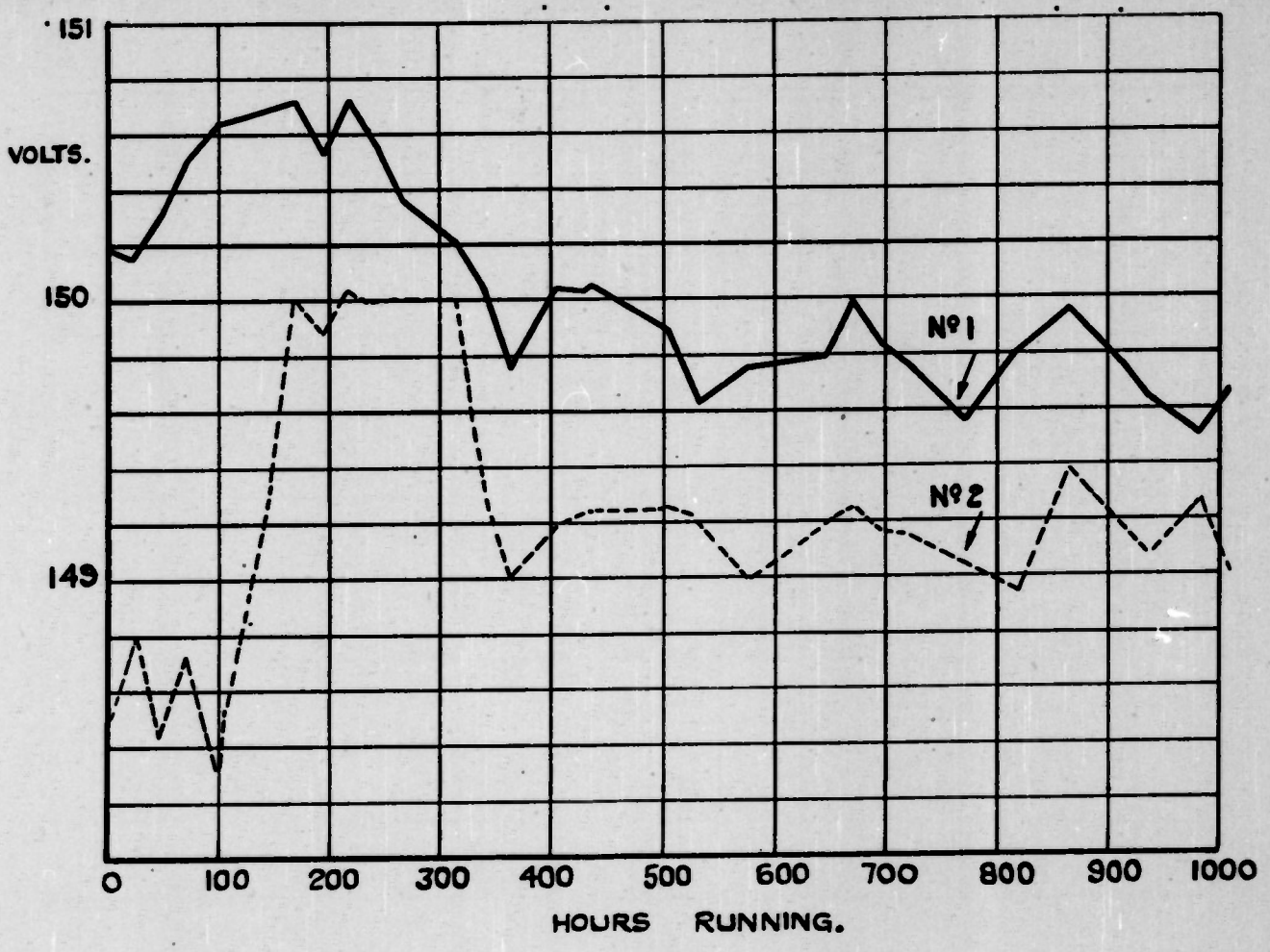

FIG. I. LIFE TEST ON VALVE TYPE CV 287 TESTED AT 3. ma.

FIG.3

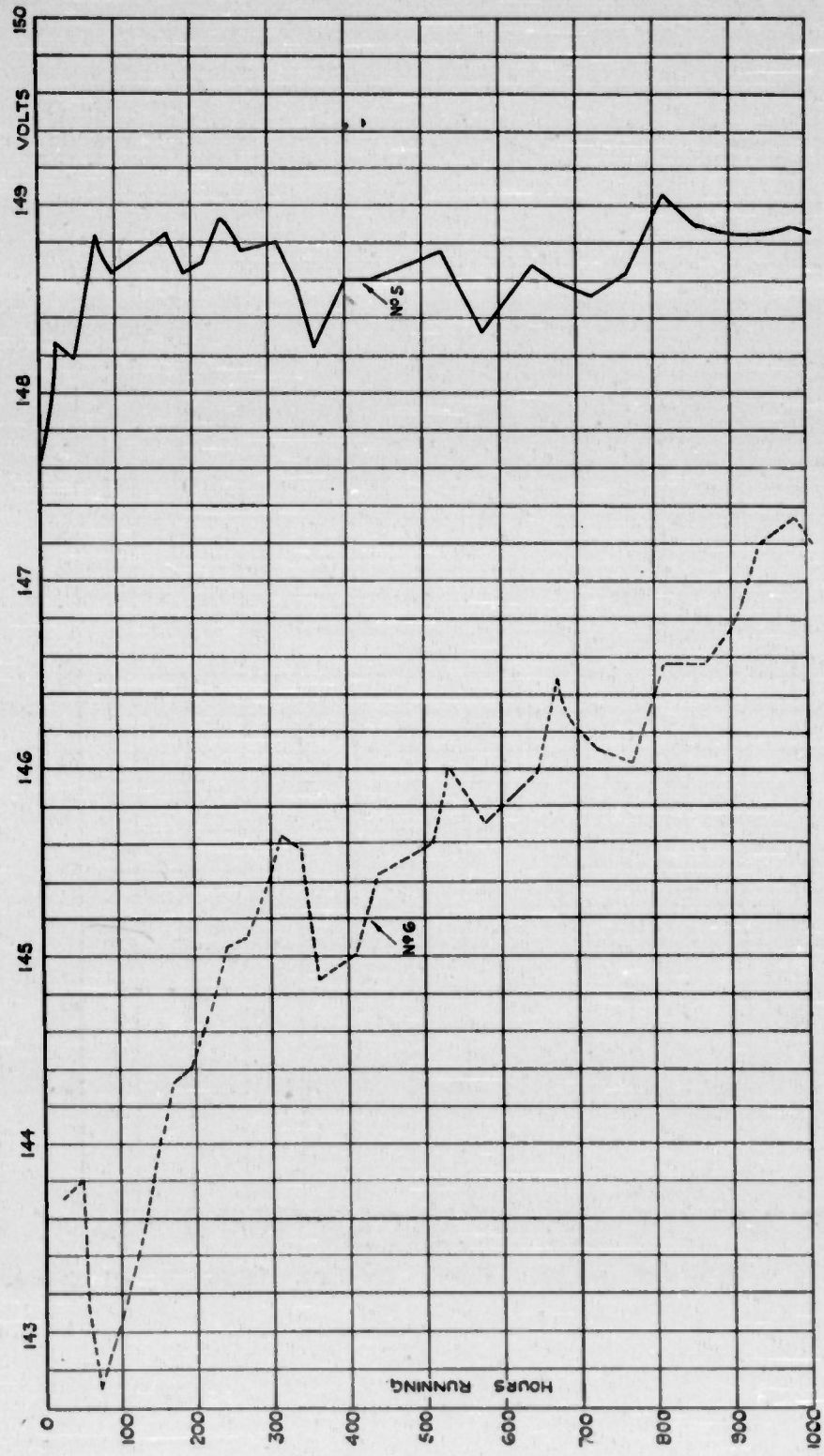

FIG.3. LIFE TEST ON VALVE TYPE CV.287 TESTED AT 6 ma.

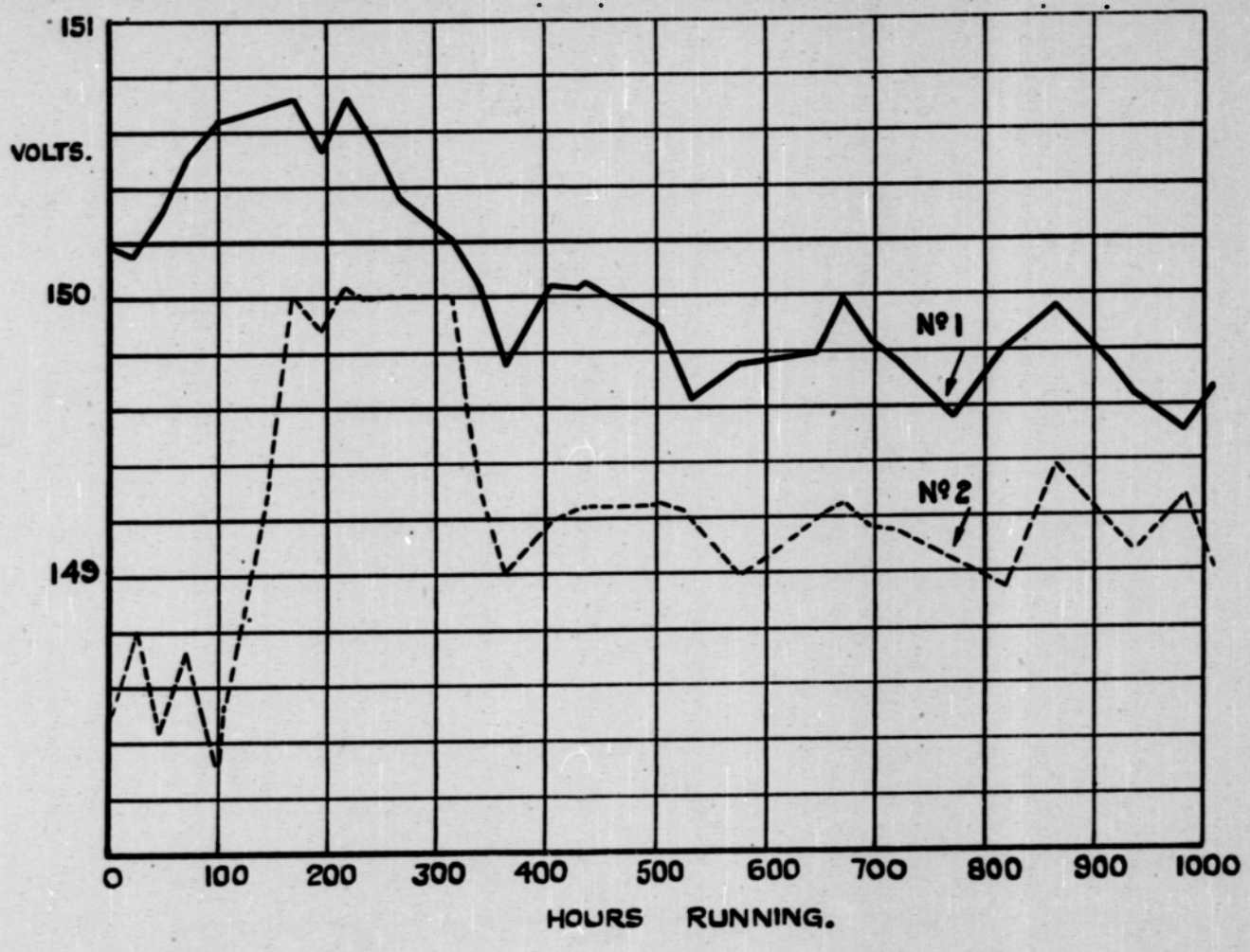

FIG. I. LIFE TEST ON VALVE TYPE CV 287 TESTED AT 3. ma.

REPORT EL.1408
FIG. I.

Nº EL.18170.

FIG. 4.

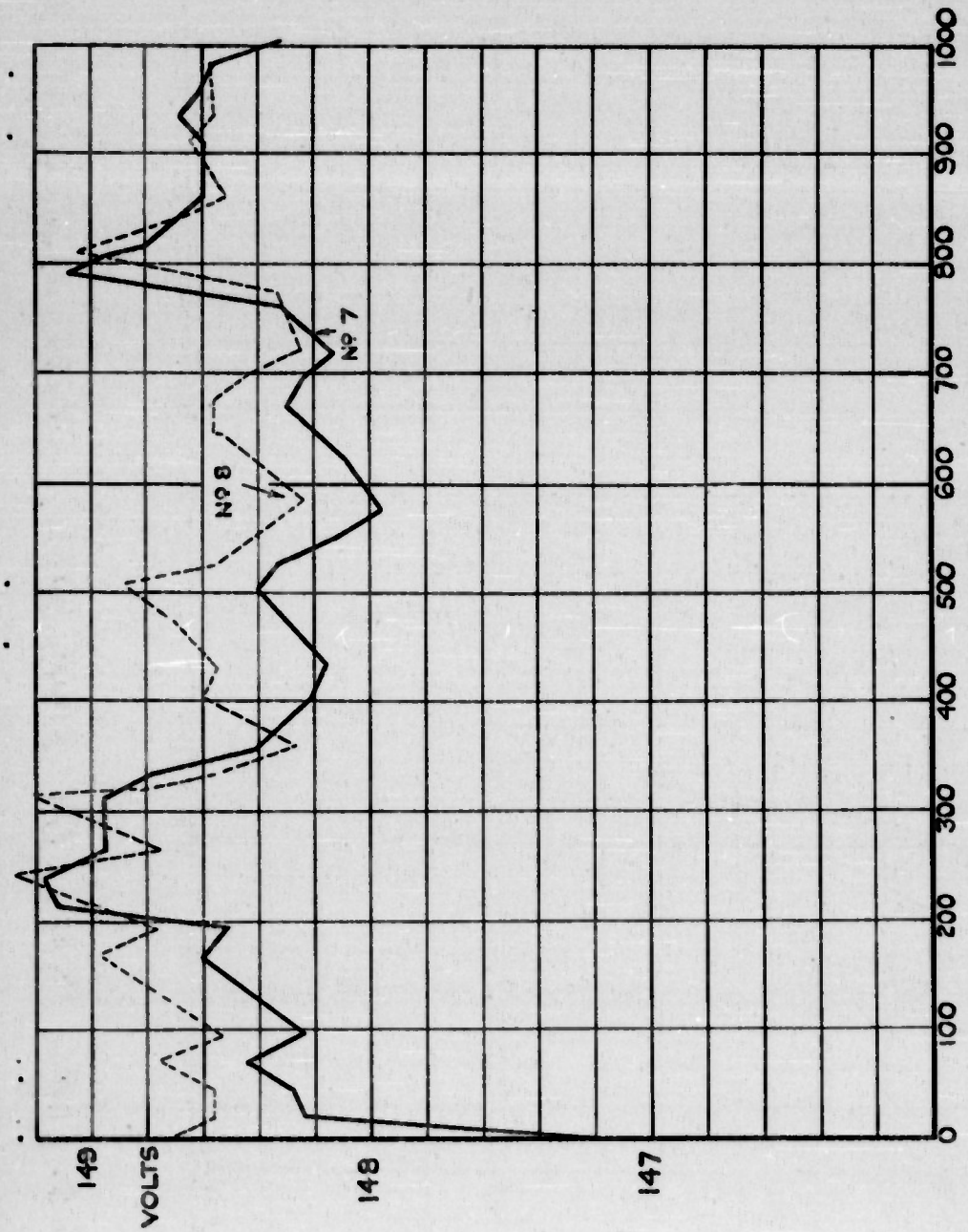

FIG. 4 LIFE TESTS ON VALVE C.V. 287 TESTED AT 6 m.a.

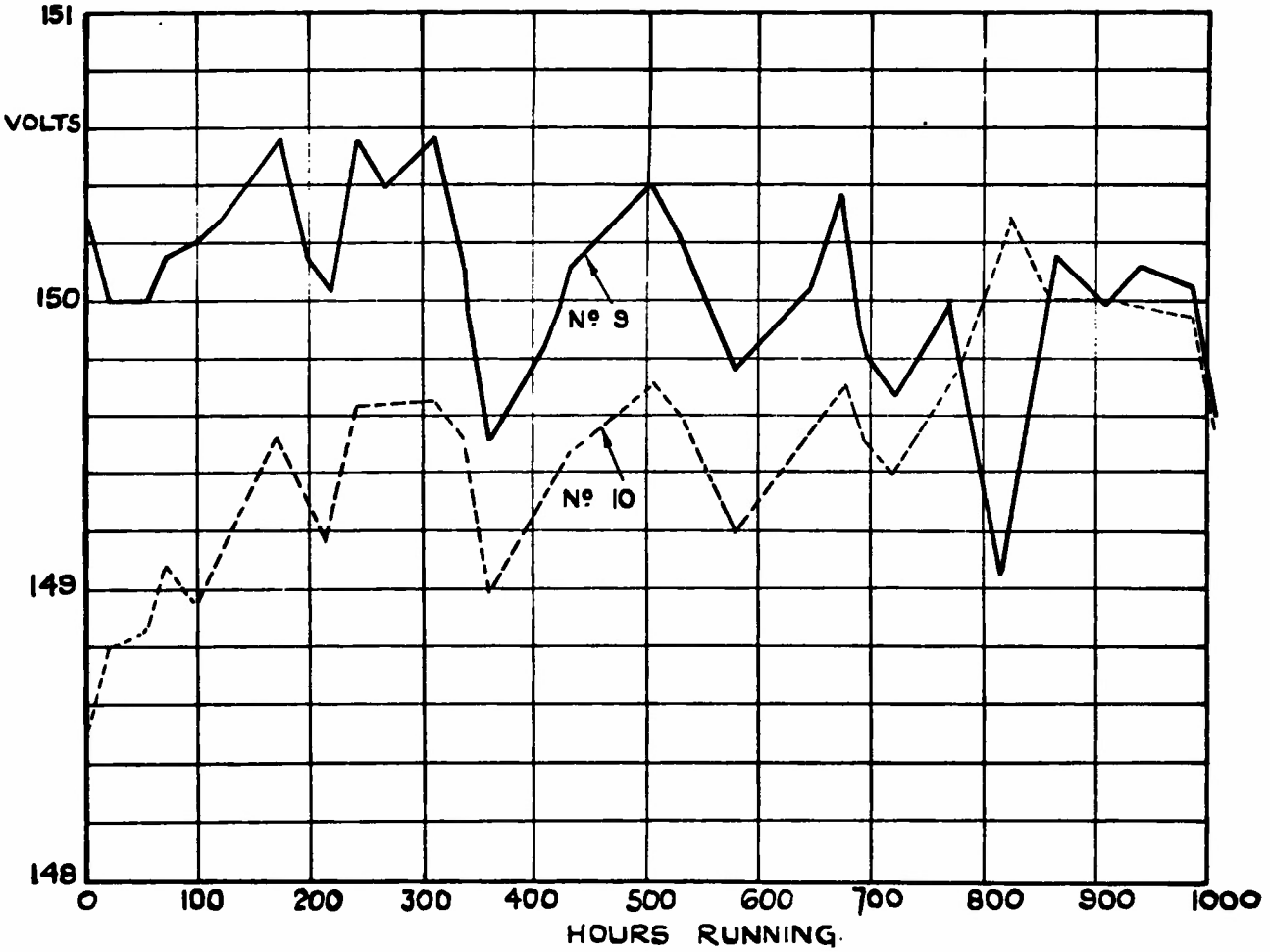

FIG. 5. LIFE TESTS ON VALVE TYPE CV 287 TESTED AT 9 ma.

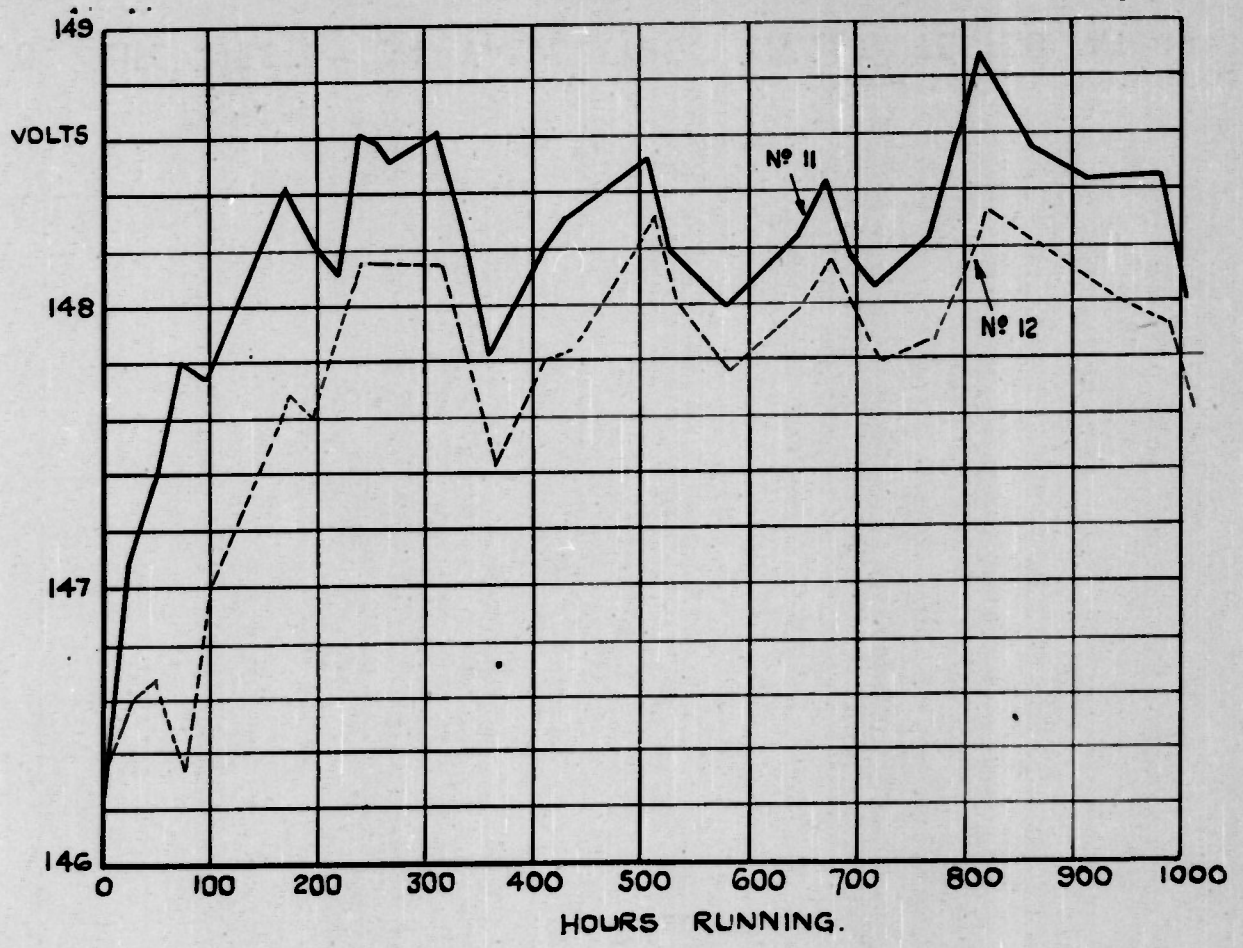

FIG. 6 LIFE TESTS ON VALVE TYPE CV287 TESTED AT 9 ma

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